15 'Note on the Occurrence and Significance of the Musculus Tibio-astragalus': Dr. McMurrich. Discussed by Dr. Huntington.

16. 'Nuclear Changes in the Muscle Cell': Dr. Eycleshymer, Chicago. Discussed by Dr. Barker.

17. 'The Plesiosaurian Skull': Dr. Williston, Lawrence, Kansas. Discussed by Dr. Huntington.

18. 'The Shape of the Pyloric Glands of the Cat': Dr. DeWitt. Presented by Dr. Huber, Ann Arbor.

19. 'An Illustration of the Value of the Functional System of Neurones as a Morphological Unit in the Nervous System': Dr. Herrick, Denison University, Ohio.

20. Dr. Terry showed his specimen of *Situs inversus*.

21. 'The Sphincter superior': Dr. R. C. Bourland, University of Michigan. Read by Dr. McMurrich. Discussed by Dr. Huntington.

22. 'Development and Variation in Distribution of the Thoracico-abdominal Nerves': Dr Bardeen, Baltimore. Discussed by Dr. Huntington.

23. 'The Ducts of the Pancreas': Dr. D. G. Revell, Chicago. Discussed by Dr. Huntington.

24. 'Variations in the Distribution of the Bile Ducts of the Liver of the Cat': Dr. Horace Johnson, Madison, Wis. Discussed by Dr. Huntington.

25. 'Contribution to the Morphology of the Cerebellum': Dr. Stroud, Cornell University. Read by the Secretary.

26. 'Histogenesis of the Sensory Nerves of Amphibia': Dr. Harrison, Baltimore. Discussed by Drs. Huber and Herrick.

27. 'The Growth of the Mammalian Spinal Ganglion': Dr. Donaldson, Chicago. Discussed by Drs. Huber and Huntington.

28. 'The Frontal Fissures in the Brains of Two Natives of British New Guinea': Dr. Huntington.

The following papers were read by title:

1. 'On the Development of Connective Tissue Fibrils': Dr. Mall, Baltimore.

2. 'Unusual Forms of Placentation': Dr. Webster.

3. 'Contribution to the Anatomy of the Scapula': Dr. Hrdlicka, New York City.

4. 'Certain Racial Characteristics of the Base of the Skull': Dr. Hrdlicka.

5. 'On Certain Anomalies of Bones': Dr. Dorsey, Chicago.

6. 'Some Anomalies of Blood-vessels': Dr. Blair, St. Louis.

7. 'Two Specimens of Anomalous Viscera with Left-sided Appendix': Dr. Holmes, Philadelphia.

8. 'Models of Human Pharynx of First Six Weeks' Development': Dr. Sudler, Baltimore.

9. 'The Ducts of the Submaxillary Glands': Dr. Flint, San Francisco.

10. 'Contribution to the Encephalic Anatomy of the Races': E. A. Spitzka, New York City.

11. 'Description of the Brain of a Regenticide': Mr. Spitzka.

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*A PLEA FOR GREATER SIMPLICITY IN THE LANGUAGE OF SCIENCE.**

Scientific ideas are with difficulty soluble in human speech. Man, in his contemplation of the flux of phenomena at work all about him, is embarrassed by the want of a vehicle of thought adequate for expression, as a child whose stammering accents do not permit him to tell his mother the new ideas which suddenly crowd upon him when he meets with something alien to his experience.

Our knowledge of the mechanism of nature has been undergoing a process of growth, much of which has been sudden. It is not surprising, therefore, that the incompletely formed ideas of science should become translated into clumsy language and that inexact thinking should be evidenced by vagueness of expression. This inexactness is often veiled by the liberal use of sonorous Greek-Latin words.

The growth of knowledge has required an increase in the medium of intellectual exchange. New conceptions have called for new terms. Sir Courtenay Boyle has pointed out that the purity of a nation's coinage is properly safeguarded, while the verbal coinage of its national language is subject to no control. Specially qualified persons prepare the standards of gold and silver. This insures the absolute purity of the measures of commercial exchange and gives the English sovereign and the American gold piece, for example, an assured circulation along all the ave-

*A paper read before Section E of the American Association for the Advancement of Science, August 28, 1901.

nues of commerce. It is not so with the standards of speech. The nation debases its language with slang, with hybrid and foreign words, the impure alloys and the cheap imports of its verbal coinage, mere tokens which should not be legal tender on the intellectual exchanges. France has an academy which in these matters has much of the authority given to the Mint, whose assayers test our metal coins; but in our country the mintage of words is wholly unrestricted, and, as a consequence, the English language, circulating as it does to all the four corners of the globe, has received an admixture of fragments of speech taken from various languages, just as the currency with which one is paid at the frontier, where empires meet, includes the coinage of several governments, each of which passes with an equally liberal carelessness.

Science ignores geographical lines and bemoans the babel of tongues which hinders the free interchange of ideas between all the peoples of the earth. Nevertheless, the international character of technical literature is suggested by the fact that three languages, French, German and English, are practically recognized as the standard mediums of intellectual exchange. One of these affords the most lucid solvent of thought, another is the speech of the most philosophical of European people and the third goes with world-wide dominion, so that each has a claim to become the recognized language of science. The brotherhood of thinking men will have been fully recognized when all agree to employ the same tongue in their intercourse, but such a 'far-off divine event' is not within the probabilities of the present, consequently there remains only for us to make the best of our own particular language and to safeguard its purity, so that when it goes abroad the people of other countries may at least be assured that they are not dealing with the debased currency of speech.

Barrie has remarked that in this age the man of science appears to be the only one who has anything to say—and the only one who does not know how to say it. It is far otherwise in politics, an occupation which numbers among its followers a great many persons who have the ability for speaking far beyond anything worth the saying that they have to say. Nor is it so in the arts, the high priests of which, according to Huxley, have 'the power of expression so cultivated that their sensual caterwauling may be almost mistaken for the music of the spheres.' In science there is a language as of coded telegrams, by the use of which a limited amount of information is conveyed through the medium of six-syllabled words. Even when not thus overburdened with technical terms it is too often the case that scientific conceptions are conveyed in a raw and unpalatable form, mere indigestible chunks of knowledge, as it were, which are apt to provoke mental dyspepsia. Why, I ask, should the standard English prose of the day be a chastened art and the writing of science, in a great scientific era, merely an unkempt dressing of splendid ideas? The luminous expositions of Huxley, the occasional irradiating imagery of Tyndall, the manly speech of Le Conte, and of a very few others, all serve simply to emphasize the fact that the literature of scientific research as a whole is characterized by a flat and ungainly style, which renders it distasteful to all but those who have a great hunger for learning.

To criticism of this sort the professional scientist can reply that he addresses himself not to the public at large, but to those who are themselves engaged in similar research, and he may be prompted to add to this the further statement that he cannot pitch the tone of his teaching so as

to reach the unsensitive intelligence of persons who lack a technical education. Furthermore, he will claim that he cannot do without the use of the terms to which objection is made. However, in condemning the needless employment of bombastic words of classical origin, in place of plain English, I do not wish to be understood as attacking all technical terms. They are a necessary evil. Some of them are instruments of precision invented to cover particular scientific ideas. Old words have associations which sometimes unfit them to express new conceptions and therefore fresh words are coined. The complaint lodged against the pompous, ungainly wordiness of a large part of the scientific writing of the day is that it is an obstacle to the spread of knowledge.

Let us consider the subject as it is thus presented. In the first place, does the excessive use of technical terms impede the advancement of science? I think it does. It kills the grace and purity of the literature by means of which the discoveries of science are made known. Ruskin, himself a most accurate observer of nature, and also a geologist, said that he was stopped from pursuing his studies 'by the quite frightful inaccuracy of the scientific people's terms, which is the consequence of their always trying to write mixed Latin and English, so losing the grace of the one and the sense of the other.' But grace of diction is not needed, it may well be said; that is true, and it is also true that a clear, forceful, unadorned mode of expression is more difficult of attainment and more desirable in the teaching of science than either grace or fluency of diction. One must not, as Huxley himself remarks, 'varnish the fair face of Truth with that pestilent cosmetic, rhetoric,' and Huxley most assuredly solved the problem of how to avoid rhetorical cosmetics and yet convey deep reasoning on the most complex of subjects in addresses which are not only as clear as a trout stream, but are also brightened by warm touches of humanity, keen wit and the glow of his own courageous manhood. Nevertheless, though clearness of expression be the first desired, yet grace is not to be scorned. When you have a teaching to convey, it is well to employ all the aids which will enable you to get a sympathetic hearing. Man lives not by bread alone, much less by stones. He likes his mental food garnished with a sauce. Let the cooking be good, of course, but a *chef* knows the value of a well-seasoned adjunct to the best dish.

Our language is capable of a grace and a finish greater than we give it credit. That it is possible to write on geology, for instance, in the most exquisite simple English has been proved by Ruskin, whose 'Deucalion' and 'Modern Painters' contain many pages describing accurately the details of the structure of rocks and mountains, and dealing with their geological features in language which is marked by the most sparing use of words which have not an Anglo-Saxon origin.

The next aspect of the enquiry is whether the language of science, apart from the view of mere grace of style in literature, is not likely, in its present everyday form, to delay the advance of knowledge by its very obscurity. Leaving the reader's feelings out of the argument, for the present, it seems obvious that the whole purpose of science, namely, the search after truth, which is best advanced by accuracy of observation and exactness of statement, is hindered by a phraseology which sometimes means very much but oftener means very little, and, on the whole, is most serviceable when required as a cloak for ignorance. To distinguish between what we know and what we think we know, to comprehend accurately the little that we do know, surely these are

the foundations of scientific progress. If a man knows what a thing really is, he can say so, describing it, for example, as being black or white; if he does not know, he masks his ignorance by stating in a few Greek or Latin terms that it partakes of the general quality of grayness. Writers get into the habit of using words that they do not clearly understand themselves and which, as a consequence, must fail in conveying an exact meaning to their readers. Many persons who possess only the smattering of a subject are apt to splash all over it with words of learned sound which are more quickly acquired, of course, than the reality of knowledge. Huxley said that if a man does really know his subject "he will be able to speak of it in an easy language and with the completeness of conviction, with which he talks of an ordinary everyday matter. If he does not, he will be afraid to wander beyond the limits of the technical phraseology which he has got up." If any scientific writer should complain that simplicity of speech is impracticable in dealing with essentially technical subjects, I refer him to the course of lectures delivered by Huxley to workingmen, lectures which conveyed original investigations of the greatest importance in language which was as easily understood by his audience as it was accurate when regarded from a purely professional standpoint.

Science has been well defined as 'organized common sense'; let us then express its findings in something better than a mere jargon of speech and avoid that stupidity which Samuel Johnson, himself an archsinner in this respect, has fitly described as 'the immense pomposity of sesquipedalian verbiage.' George Meredith, a great mint-master of words, has recorded his objection to 'conversing in tokens not standard coin.' Indeed the clumsy latinity of much of our scientific talk is an inheritance from the schoolmen of the past; it is the degraded currency of a period when the vagaries of astrology and alchemy found favor among intelligent men.

Vagueness of language produces looseness of knowledge in the teacher as well as the pupil. Huxley, in referring to the use of such comprehensive terms as 'development' and 'evolution,' remarked that words like these were mere 'noise and smoke,' the important thing being to have a clear conception of the idea signified by the name. Examples of this form of error are easy to find. The word 'dynamic' has a distinct meaning in physics, but it is ordinarily employed in the loosest possible manner in geological literature. Thus, the origin of a perplexing ore deposit was recently imputed to the effects produced by the 'dynamic power' which had shattered a certain mountain. 'Dynamic' is of Greek derivation and means powerful, therefore a 'powerful power' had done this thing; but in physics the word is used in the sense of active, as opposed to 'static' or stationary, and it implies motion resulting from the application of force. In the case quoted, and in many similar instances, the word 'agency' or 'activity' would serve to interpret the hazy idea of the writer, and there is every reason to infer, from the context, that he substituted the term 'dynamic power' merely as a frippery of speech. It is much easier to talk grandiloquently about a 'dynamic power' which perpetrates unutterable things and reconstructs creation in the twinkling of an eye than it is to make a careful study of a region, trace its structural lines and decipher the relations of a complicated series of faults. When this has been done and a writer uses comprehensive words to summarize activities which he has expressly defined and described, then indeed he has given a meaning to such words which warrants him in the use of them.

In this connection it is amusing to remember how Ruskin attacked Tyndall for a similar indiscretion. The latter had referred to a certain theory which was in debate, and had said that it, and the like of it, was 'a dynamic power which operates against intellectual stagnation.' Ruskin commented thus: "How a dynamic power differs from an undynamic one, and, presumably, also, a potestatic dynamis from an unpotestatic one—and how much more scientific it is to say, instead of—that our spoon stirs our porridge—that it 'operates against the stagnation of our porridge,' Professor Tyndall trusts the reader to recognize with admiration."

Among geological names there is that comfortable word 'metasomatosis' and its offspring of 'metasomatic interchange' 'metasomatic action,' 'metasomatic origin,' etc., etc. To a few who employ the term to express a particular manner in which rocks undergo change, it is a convenient word for a definite idea, but for the greater number of writers on geological subjects it is a wordy cloud, a nebular phrase, which politely covers the haziness of their knowledge concerning a certain phenomenon. When you don't know what a thing is, call it a 'phenomenon'! Instances of mere vulgarity of scientific language are too numerous to mention. 'Auriferous' and 'argentiferous' are ugly words. They are unnecessary ones also. The other day a metallurgical specialist spoke of 'auriferous amalgamation' as though any process in which mercury is used could be gold-bearing unless it was part of the program that somebody should add particles of gold to the ore under treatment. A mining engineer, of the kind known to the press as an expert, described a famous lode as traversing 'on the one hand a feldspathic tufaceous rock' and 'on the other hand a metamorphic matrix of a somewhat argillo-arenaceous composition.' This is scientific nonsense, the mere travesty of speech. To those who care to dissect the terms used it is easily seen that the writer of them could make nothing out of the rocks he had examined, save the fact that they were decomposed and that the rock which he described last might have been almost anything, for all he said of it; for his description, when translated, means literally a changed matter of a somewhat clayey-sandy composition, which, in Anglo-Saxon, is m-u-d! The 'somewhat' is the one useful word in the sentence. Such language may be described in the terms of mineralogy as metamorphosed English pseudomorphic after blatherskite. Some years ago, when I was at a small mine near Georgetown, in Colorado, a professor visited the underground workings and was taken through them. He immediately began to make a display of verbal fireworks which bewildered the foreman and the other miners whom he met in the mine, all save one, a little Cornishman, who, bringing him a bit of the clay which accompanied one of the walls of the lode, said to him, 'What do 'ee call un, you?' The professor replied, 'It is the argillaceous remnant of an antediluvian world.' Quick as a flash came the comment, 'That's just what I told me pardner.' He was not deceived by the vapor of words.

Next consider the position of the reader. It is scarcely necessary at this date to plead for the cause of technical education and the generous bestowal of the very best that there is of scientific knowledge. The great philosophers of that New Reformation which marked the era of the publication of 'The Origin of Species' have given most freely to all men of their wealth of learning and research. When these have given so much we might well be less niggardly with our small change and cease the practice of distributing, not good wholesome intellectual bread, but the mere stones of

knowledge, the hard fossils of what were once stimulating thoughts. In the ancient world the Eleusinian mysteries were withheld from the crowd and knowledge was the possession of a few. Do the latter day priests of science desire to imitate the attendants of the old Greek temples and confine their secrets to a few of the elect by the use of a formalism which is the mere abracadabra of speech? Among certain scientific men there is a feeling that scientists should address themselves only to fellow scientists, and that to become an expositor to the unlearned is to lose caste among the learned. It is the survival of the narrow spirit of the dark ages, before modern science was born. There are not many, however, who dare confess to such a creed, although their actions may occasionally endorse it. On the whole, modern science is nothing if not catholic in its generosity. 'To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life' was the avowed purpose of the greatest of the philosophers of the Victorian era.

There are those who are full of a similar good will, but they fail in giving effect to it because they are unable to use language which can be widely understood. In its very infancy geology was nearly choked with big words, for Lyell, the father of modern geology, said, seventy years ago, that the study of it was 'very easy, when put into plainer language than scientific writers choose often unnecessarily to employ.' At this day even the publications of the Geological Surveys of the United States and the Australian colonies, for example, are occasionally restricted in usefulness by erring in this respect, and as I yield to none in my appreciation of the splendid service done to geology and to mining by these surveys, I trust my criticism will be accepted in the thoroughly friendly spirit with which it is offered. It seems to me that one might almost say that certain of these extremely valuable publications are 'badly' prepared because they seem to overlook the fact that they are, of course, intended to aid the mining community in the first place and the public, whether lay or scientific, only secondarily. From a wide experience among those engaged in mining I can testify that a large part of the literature thus prepared is useless to them and that no one regrets it more deeply than they, because there is a marked tendency among this class of workers to appreciate the assistance which science can give. Take, for example, a sentence like the following, extracted from one of the recent reports of the U. S. Geological Survey. "The ore forms a series of imbricating lenses, or a stringer lead, in the slates, the quartz conforming as a rule to the carunculated schistose structures, though occasionally breaking across laminæ, and sometimes the slate is so broken as to form a reticulated deposit." This was written by one of our foremost geologists and, when translated, the sentence is found to convey a useful fact, but is it likely to be clear to anyone but a traveling dictionary? A thoroughly literary man might know the exact meaning of the two or three very unusual words which are employed in this statement, but the question is, will it be of any use whatever even to a fairly educated miner, or be understood by those who pay for the preparation of such literature, namely, the taxpayers? An example of another kind is afforded by a Tasmanian geologist who recently described certain ores as due to 'the effects of a reduction in temperature of the hitherto liquefied hydroplutonic solutions, and their consequent regular precipitation.' These solutions, it is further stated, presumably for the guidance of those who wield the pick,

ascended in the form of metallic superheated vapors which combined eventually with ebullient steam to form other aqueous solutions, causing geyser-like discharges at the surface, aided by subterranean and irrepressible pressure.' At the same time certain 'dynamical forces' were very busy indeed and 'eventuated in the opening of fissures'—of which one can only regret that they did not swallow up the author as Nathan and Abiram were once engulfed in the sight of all Israel.

It will be well to contrast these two examples of exuberant verbosity because the first befogs the statement of a scientific observation of value, made by an able man, while the second cloaks the ignorance of a charlatan, who masquerades his nonsense in the trappings of wisdom. Here you have an illustration of the harmfulness of this kind of language, which obscures truth and falseness alike, to the degradation of science and the total confusion of those of the unlearned who are searching after information.

Let the writer on scientific matters learn the derivation of the words he uses and then translate them literally into English before he uses them, and thereby avoid the unconscious talking of nonsense. If he knows not the exact meaning of the terms which offer themselves to his pen, let him avoid them and trust to the honest aid of his own language. 'Great part of the supposed scientific knowledge of the day is simply bad English, and vanishes the moment you translate it,' says Ruskin. The examples already given illustrate this. 'Every Englishman has, in his native tongue, an almost perfect instrument of literary expression,' so says Huxley, and he illustrated his own saying. Huxley and Ruskin were wide apart in many things and yet they agreed in this. Ruskin proved abundantly that the language of Shakespeare and the Bible can be used as a weapon of expression keen as a Damascus saber when it is freed from the rust of classic importations, which make it clumsy as a crowbar.

There is yet another reason against the excessive use of Greek-English words, in particular. Greece is not a remnant of extinct geography, but an existing land with a very active people and a living language. The terms which paleontology has borrowed from the Greek may be returned by the Greeks to us. And, as Ruskin points out, "What you, in compliment to Greece call a 'Dinotherium,' Greece, in compliment to you, must call a 'Nasty-beastium,' and you know the interchange of compliments can't last long."

In all seriousness, however, is it too much to ask that such technical terms as are considered essential shall not be used carelessly, and that in publications intended for an untechnical public, as are most government reports, an effort be made to avoid them and, where unavoidable, those which are least likely to be understood shall be translated in footnotes. Even as regards the transactions of scientific societies, I believe that those of us who are active members have little to lose and much to gain by confining the use of our clumsy terminology to cover ideas which we cannot otherwise express. By doing so we shall contribute, I earnestly believe, to that advancement of science which we all have at heart.

The words which, at first, are the exclusive privilege of the specialist, gradually extend into wider use, following in the wake of that diffusion of scientific knowledge which is one of the objects of this Association. We believe that to get alongside facts, to apply the best knowledge available, to seek truth for its own sake, is as essential to the well-being of the individual life as it is to the success of a

machine shop, and as beneficial to the community as it is to a smelting works.

In furtherance of this principle we must remember that language in relation to ideas is a solvent, the purity and clearness of which affect that which it bears in solution. Whewell, in 'The Philosophy of the Inductive Sciences,' has expressed this view of the matter with noble eloquence. 'Language,' he said, 'is often called an instrument of thought, but it is also the nutriment of thought; or rather, it is the atmosphere in which thought lives; a medium essential to the activity of our speculative powers, although invisible and imperceptible in its operation, and an element modifying, by its qualities and changes, the growth and complexion of the faculties which it feeds.'

In considering the subject from this standpoint, there is borne in upon the mind a suggestion which carries our thought far beyond the confines of the matter under discussion. Such power of speech as man possesses is a faculty which appears to divide him from all other living things, while at the same time the imperfection of it weighs him down continually with the sense of an essential frailty. To be able to express oneself perfectly would be divine, to be unable to make oneself understood *is* human. In 'Man's Place in Nature,' Huxley points out that the endowment of intelligible speech separates man from the brutes which are most like him, namely, the anthropoid apes, whom he otherwise resembles closely in substance and in structure. This endowment enables him to transmit the experience which in other animals is lost with each individual life; it has enabled him to organize his knowledge and to hand it down to his descendants, first by word of mouth and then by written words. If the experience thus recorded were properly utilized, instead of being largely disregarded, then man's advancement in knowledge and conduct would enable him to emphasize, much more than it is permitted him at present, his superiority over the dumb brutes. Considered from this standpoint language is a factor in the evolution of the race and an instrument which works for ethical progress. It is a gift most truly divine which should be cherished as the ladder which has permitted of an ascent from the most humble beginnings and leads to the heights of a loftier destiny, when man, ceasing to stammer forth in accents which are but the halting expression of swift thought, shall photograph his mind in the fulness of speech, and, neither withholding what he wants to say nor saying what he wants to withhold, shall be linked to his fellow by the completeness of a perfect communion of ideas.

T. A. RICKARD.

DENVER.

SCIENTIFIC BOOKS.

Geschichte der Metalle. Vom Verein zur Beförderung des Gewerbfleisses mit dem ersten Tornow-Preise gekrönte Preisschrift. Von ADELBERT RÖSSING. Berlin, Verlag von Leonhard Simon. 1901. 8vo. Pp. vi + 274.

This 'History of Metals' forms a great contrast to the 'History of the Precious Metals' by Alex. Del Mar, reviewed in SCIENCE for December 6, 1901. The latter, as we have shown, is a philosophic study of the sources and history of the *two* metals, silver and gold, the work under review deals with the occurrence (in nature), the history of discovery the chemical, metallurgical and electrical preparation, the statistics of production and the cost price of *all* the known metals, fifty-five in number. Dr. Rössing's treatise forms, consequently, a most timely and valuable complement to that by Del Mar.

The arrangement of matter is very convenient for reference; after an introduction occupying twenty-one pages, the metals are discussed in alphabetic order, the treatment